

NASA TECH BRIEF



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Coulometer Battery State-of-Charge Indicator

A mercury-column electrochemical coulometer has been used as a means of indicating the state-of-charge of secondary batteries. The coulometer is the element which integrates the ampere-hours into and out of the battery. The state-of-charge is the difference between the known fully-charged battery capacity and the net ampere-hours removed. This device was originally investigated as a state-of-charge indicator for space power systems, but also has application for batteries used for industrial purposes.

The mercury-column coulometer is a readily available ampere-hour device, featuring small size and relative simplicity. It is basically a linear ampere-hour integrating device consisting of a sealed glass tube containing two columns of mercury separated by a gap containing an electrolyte. As current is passed through the coulometer, mercury is transferred from one column to the other. The gap moves, and its position is an indication of the ampere-hour integral. Battery ampere-hour capacity, however, is not constant, and varies with discharge rate. Also, more ampere-hours are required for recharge than were removed during discharge.

A drive circuit for a mercury-column coulometer has been designed using operational amplifier techniques to match the general nonlinear charge-discharge characteristics of an alkaline battery. Together with the coulometer, it forms a battery state-of-charge indicator. The current integrated by the coulometer has a variable relation to the input voltage obtained from a battery current shunt. At high discharge battery currents, the ratio of coulometer current to shunt voltage is greater than at low discharge currents,

thereby compensating for reduced battery capacity in high discharge rates.

This circuit was built and tested. The effect of ambient temperature variation from 0° to 50°C on the indicated state-of-charge was approximately 3%. The error correction portion of the circuit maintained the drift of the state-of-charge indication to within 2% in 100-hour tests.

Notes:

1. The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.65)

Reference:

NASA-TN-D-5773 (N70-32261), Mercury
Electrochemical Coulometer as a Battery
State-of-Charge Indicator

2. Requests for further information may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B70-10323

Patent status:

No patent action is contemplated by NASA.

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